BOTANICAL GAZETTE

MAY, 1894.

A study of Quercus Leana.[1]

E. J. HILL.

The oak known as *Quercus Leana* Nutt. is considered a hybrid of the shingle oak, *Q. imbricaria* Mx., and the scarlet oak, *Q. coccinea* Wang., the latter including the black oak, *Q. tinctoria* Bartram, as a variety. It has been sparingly found in the central states, and also near Washington in the east. The original tree, figured and described by Nuttall in his continuation of Michaux's Silva,[2] was detected about fifty years ago by T. G. Lea, near Cincinnati, O. Since then it has been found in several places in Illinois and Missouri by Dr. Mead, Dr. Engelmann, and others. In most of these localities but a single tree, or a couple of trees, were seen.[3] Some of these have since been destroyed. Like other hybrid oaks it is very rare, though more frequent perhaps than has been reported, since it is easily overlooked unless one is familiar with the varied characters of some of the biennial-fruited oaks, particularly the species with lobed leaves.

In the summer of 1890 I came across a form of this hybrid in greater numbers than have been reported elsewhere, and have observed them each season since. The locality is near Willow Springs, about fifteen miles southwest of Chicago. Eight or ten pretty clear cases of hybridity were at first made out, and some others noticed which seemed to show the effects of crossing, but were not distinct enough to be satisfactorily separated from the typical Q. imbricaria. Most of these trees have since been cut down, and last year but one remained, though stool shoots were starting from the stumps of some

[1] Forming part of a paper on "Natural Hybrids" read before the Chicago Academy of Sciences.

[2] l. c. 1: *pl.* 5 bis.

[3] Engelmann, Papers on American Oaks. Botanical Works, 405.

that had been removed, showing that the roots readily produce a coppice. Attention was first called to these trees by finding twigs torn off and scattered over the ground by a heavy storm of wind. Among them were some carrying leaves of an unfamiliar kind of oak, which were soon traced to the trees from which they came. The trees were mixed with others, mostly oaks represented in the hybrid, within an area of a couple of acres. The soil was of a gravelly nature, almost exclusively bearing oaks and hickories, with an undergrowth of hazel in the more open spaces. The hybrid trees were from fifty to sixty feet high, their bolls free from limbs for the first fifteen or twenty feet, except from the occasional presence of adventitious shoots. The largest tree was three feet nine inches in circumference at a foot and a half above the surface of the ground, just beyond the swelling occasioned by the roots. The rest were about a foot in diameter, so nearly of the same girth and height as to indicate that they were of about the same age. The outer bark could not be distinguished from that of the typical shingle oak of the same age and size, being but slightly furrowed, close and rather smooth, and of a dark gray color. The trunks did not have the black, rough and deeply furrowed bark so characteristic of the black oak even on small trees, for it begins to have this character quite early in life. A section of the bark showed essentially the same characteristics as that of the shingle oak, the inner bark being of a reddish or reddish-yellow color.

The leaves are from three to seven inches long, and one third as wide, on peduncles about an inch in length. They are somewhat pointed, and with a variable base, either acute, wedge-shaped, or rounded, sometimes approaching a cordate form, the broader leaves usually with a rounder or fuller base. The margin varies from forms slightly undulate to those irregularly sinuate-lobed to coarsely dentate-lobed. When lobed the segments are either rounded or acute, and when acute are triangular in form. The sharp lobes end in a bristle, and the adjoining sinuses are deeper and narrower than those in leaves with rounded lobes. In this lobation the influence of the black oak is seen, changing the form of leaves with an entire margin, characteristic of the shingle oak, to those approaching the less divided kinds of the black oak. The leaves on the stool shoots are larger, and are less divided than

those on the trees. This is apt to be the case in the young growth of all the oaks. The lobes are acute, or blunt, most of them tipped with a bristle. Some leaves are pointed as on the trees, and others are broader at the apex, ending in three lobes, resembling those figured by Dr. Brendel from a hybrid oak, Q. Leana, near Peoria, Ill.[4] The leaves on the upper part of the trees showed a tendency to a deeper lobation than those on the lower limbs, especially than those on adventitious shoots of the trunk. The leaf surface is glossy, having about the same luster and color as that of the black and the scarlet oaks, but paler than in the shingle oak. In the mature leaves there is a trace of pubescence along the midrib and primary veins beneath. Young leaves, as well as those of the stool-shoots, are more or less rusty-pubescent, especially on the lower surface, about as much so as in Q. imbricaria. The margin of the leaves, particularly when young, is a little revolute, showing in this as well as in the pubescence the effects of the shingle oak. The winter buds are ovate, blunt three- to five-angled, larger than those of Q. imbricaria, but not so large or rusty-downy as those of Q. tinctoria. The hairs on the freshly started leaves are identical in structure with those of Q. imbricaria, being dense, matted, and curled or woolly, while those of the black and scarlet oaks are longer, coarser, straighter and scarcely matted. The bark of the young branches is greyish-brown, with numerous roundish gray and often warty lenticels raised above the surface. The color of the bark is like that of Q. imbricaria, but the lenticels are more prominent.

The perianth of the male flower is hairy, two- to four-parted, with thin, yellowish-brown segments; the stamens are four to five with large blunt anthers, on smooth filaments one-third to one-half their length. The acorns are roundish-ovate, half an inch long, with a short blunt or truncated knob at the top. The cup is saucer-shaped, covering about one-third of the nut; the scales of the cup are pubescent, blunt and appressed, occasionally a little squarrose near the margin of the cup. The acorns, especially when fresh, are often longitudinally striped with bands of a darker color, as in many of the black-oaks. They are somewhat larger than those of the shingle-oak, with a more prominent knob, that of the latter being but slightly raised or often quite flat or nearly obsolete, with a

[4]The American Entomologist and Botanist, **2**: 316. 1870.

flat areola at its base. In the black and the scarlet oak the knob is prominent, and more pointed and conical. The acorn-cup is flattish and abruptly contracted to the short peduncle as it is in the shingle oak, while in the black and the scarlet oaks it is more rounded and tapering below, sometimes in the scarlet oak being quite conical beneath. The acorns of nearly all specimens of Q. tinctoria growing in the vicinity of the hybrid were, so far as examined, considerably larger than those of the hybrid. Their cup-scales were very pubescent, and almost always with wavy, squarrose tips. The meat of the acorns was intensely bitter, from a light to a deep yellow or orange color, not white or pale as is generally the case with the scarlet oak. The interior of the cup was yellow. The meat of the acorns of the hybrid was of a pale yellow color and was very bitter in taste. By the character of the fruit, the color of the outer bark and the rich yellowish-brown or russet tinge of the autumn leaves, the neighboring biennial-fruited oaks had the characteristics of Q. tinctoria. But the leaves were usually deeply lobed, and the inner bark, though generally yellow, was sometimes reddish as in the scarlet oak. From all indications, the hybrid seemed to be a cross of Q. tinctoria and Q. imbricaria. But the characteristics of Q. tinctoria and Q. coccinea sometimes blend so far as to make it difficult to separate them, though from careful study of the various forms I believe them to be distinct. If, as many do, we regard Q. tinctoria of Bartram a variety of Q. coccinea of Wangenheim, then the hybrids at Willow Spings would be a cross derived from the variety, not the type.

Quercus rubra occurred not far away in the same piece of woods, but no signs of hybridism were seen between the red oak and the shingle oaks in its vicinity. These were not scattered throughout the woods, but were frequent only where the hybrids were found. Two annual-fruited species, Q. alba and Q. macrocarpa, were the only other kinds observed, but such seem out of the question for parentage.

The hybrids differed somewhat from the published descriptions of Q. Leana which I have seen, combining most of the characteristics of the individual cases described from other localities. The number of trees offered a greater range for showing the influence of the double parentage. But it was quite easy to match the leaves with those which I examined in the large collection of the Engelmann herbarium, now in

the Missouri Botanic Garden at St. Louis. They do not differ materially from authenticated specimens from the original tree at Cincinnati, nor from those figured by Nuttall. As Dr. Engelmann did not specifically separate Q. tinctoria from Q. coccinea, there is no way to determine which of the two he regarded as most effective on the hybrid. He says of the hybrid: "The relationship to *imbricaria* is unquestionable, and among the lobed-leaved black oaks we must look to one of the forms of *coccinea* for the other parent, as the acorns, and especially the cup and scales, indicate." Of one growing in St. Clair county, Ill., twenty miles from St. Louis, and of which Q. rubra was at first thought to be one of the parents, he says: "The cup of the acorn is to me decisive. It is turbinate, covered with rather large canescent scales, squarrose at the tip, and very different from either *rubra* or *imbricaria*, but approaching those of *coccinea*. The globose acorn, seven lines in diameter, one-third covered by the cup, shows twenty-two to twenty-five black stripes, so common in many black-oaks."[5]

No seedlings of the hybrid were detected. Those of any of the oaks were scarce, since the wood was a pasture for horses and cattle, though not so closely pastured as to prevent a considerable undergrowth of shrubs. But it is probable that the hybrids, or some of them, considering their number, came from acorns. There is no apparent defect in the nuts, which are as plump and are produced as abundantly as those of other oaks in the vicinity. Dr. Engelmann has also noticed the scarcity of seedlings of hybrid oaks, and remarks upon it: "All of the supposed hybrids are abundantly fertile, and those of their acorns which have been tested have well germinated; in fact, as far as I know, no difference in fertility between them and the acknowledged species has been discovered. The seedlings of such questionable individuals do not seem to revert to a supposed parent, but 'come true,' as the nurserymen express it. For how many generations this may continue, and whether in time forms approaching one or the other parent may not appear, remains to be seen. At the same time it is a remarkable fact, that notwithstanding their fertility they do not seem to propagate in their natural woods. We may, perhaps, ascribe this to a lesser degree of vitality in the hybrid progeny which causes them to be crowded

[5] Botanical Works, 406.

out in the struggle for existence; one of the provisions of nature to keep the species distinct; or, as Dr. Gray suggests, fertilization by one of the parents may soon extinguish the hybrid characters."[6]

To those who question the hybridity of these oaks, and deem such forms varieties of closely related but very variable species, the answer may be made that, since hybridizing is a frequent resort of the horticulturist for the production of new varieties of plants, it is to be expected that something of the same kind will occur in nature where plants nearly related grow together promiscuously. As such crosses are effected by dusting the stigma of one species or variety with the pollen of another species or variety of the same genus, or in the case of bigeneric hybrids, of a different genus, similar results may be looked for among wild plants where this dusting must often occur whether effective or not. But it is in the highest degree efficient for plants of the same species to be cross-fertilized, and in many cases it is the sole method of fertility. It is done on so large a scale by various agencies that our surprise should not be at finding spontaneous hybrids, but that they are seemingly so rare in wild plants. Failure to produce them has to be ascribed to other causes than the lack of opportunity. And it is in genera with diœcious, and often anemophilous, flowers, such as Carex, Quercus and Salix, that hybrids have most frequently been detected in nature. Especially is this the case with willows.[7] With such genera the conditions are least complex, and the opportunities for hybridizing most frequent.

These oaks plainly show the marks of hybridism such as have been noted by various observers, and summarized by Sachs, among which the two following closely apply: (*a*) "The hybrid is possessed of external characters intermediate between those of its parent forms, usually nearly half way between. (*b*) The characteristics of the parent-forms are as a rule so transmitted to the hybrid that the influence of both is manifested in all its characters, producing a fusion of the different peculiarities."[8]

It is also very strongly in favor of their hybridity for these

[6] Botanical Works, 403.

[7] Insects, especially bees, take an active part in the pollination of willows. Wimmer, Salices Europaeae, Introduction, p. *xlviii*. Ib. Wildwachsende Bastardpflanzen, 144.

[8] Lehrbuch (4th ed.) 891. Text Book, 917.

oaks to occur only where the shingle oak is found. Having frequently and extensively traversed the woodlands in the vicinity of Chicago, and carefully examined the oaks of different localities, since they are the prevailing trees, I have only seen this form where we first meet with the shingle oak, which comes up the valley of the Desplaines as far north as Willow Springs, at least. It is on the border of the northern limits of the species in this vicinity, for it becomes a common tree only to the south. Immediately east and south in the sandy region by the head of Lake Michigan the black oak is the prevailing species, probably ten times as numerous as the other biennial-fruited oaks taken together. But leaves of the peculiar form shown by the hybrid have been detected nowhere else. There are plenty of transitions in leaf-forms between the black and the scarlet oak, and to some extent between these and the red oak, but none between them and the shingle oak except where Q. imbricaria was first encountered, for both the species and the hybrid were found the first time of visiting the locality. Though the proof from proximity may not be conclusive, when it is taken in connection with the blended characteristics of the form, it is hard to resist the conviction that the parentage was specifically double, and that the parent-forms are those whose characters are most evident in the offspring.

Englewood, Chicago.

Contributions to the histology of the Pontederiaceæ.

EDGAR W. OLIVE.

WITH PLATE XVII.

Comparatively little work has been done on the histology of the Pontederiaceæ. The roots have been studied somewhat in a comparative way by M. Treub, L. Morot, F. Hildebrand, S. Schönland, and others. A comprehensive study of the anatomy of water-plants was begun by F. Parlatore, but death prevented the completion of the work. Nine plates, however, were published in 1881. These contain among the drawings of about ninety species of water-plants a few very diagrammatic drawings of two species of Pontederia. No explanation accompanies the plates.

Solms-Laubach has a monograph of the Pontederiaceæ in A. et C. de Candolle's Monographiæ Phanerogamarum; but a short review of this[1] shows that it is systematic rather than histological. J. Duval Jouve, in 1873, investigated the diaphragms, or cross-plates, in the air-cavities of Pontederia cordata. E. M. Wilcox, in the *Journal* of the Cincinnati Soc. of Nat. Hist., July–Oct., 1893, has noted a few points in the histology of the same species.

In the botanical laboratories of Wabash College, some studies were made in the spring of 1893 upon the histology of Pontederia crassipes, a cultivated form, and since then a comparative study of all the available members of the order was undertaken and types of other aquatic plants examined. The Pontederiaceæ are aquatic herbs, growing in mud, or shallow water. There are two genera embracing four species in our northern United States flora, all but one species of which (Heteranthera limosa) are reported in our Indiana flora.[2] All the four species have been studied, as well as the cultivated Pontederia. In the world's flora there are reported twenty-three species and six genera[3] grouped under this order, principally tropical in their habitat.

Pontederia crassipes Mart. (see fig. 1) is an interesting cultivated aquatic, growing rapidly in a basin or vessel of

[1] Botanischer Jahresbericht **11**: 622. 1883.
[2] Bot. Gaz., **6**: Supplement. 1881.
[3] MacMillan, Metaspermæ of Minn. Valley. 1892.

water and spreading over the surface by means of off-shoots. It has a thick root-stock, and long roots with very many lateral rootlets, so that a light feathery appearance is given to the whole. The roots are colored a dark violet-blue. F. Hildebrand suggests that the probable biological reason for this is to provide immunity from living animals in the water by making the roots less visible to them.

A striking peculiarity is the *thick petiole* of the leaf. The lower portion is expanded into a resemblance to a pseudobulb, which serves to float the plant. The flowers of P. crassipes, as well as of *P. cordata* L., are violet blue and ephemeral. P. cordata, also, has a thick root-stock. It produces erect long-petioled mostly heart-shaped leaves, and a stem with a single leaf bearing the spike of flowers.[4]

The three species of Heteranthera, *H. reniformis* Ruiz & Pav., *H. limosa* Vahl., and *H. graminea* Vahl. are "creeping, floating, or submerged low herbs, in mud or shallow water, with a 1–few-flowered spathe bursting from the sheathing side or base of a petiole."[5]

The parts for sectioning were hardened 24–48 hours in a dehydrating apparatus and afterward imbedded in collodion. Great difficulty was experienced in infiltrating thoroughly with collodion the parts of P. crassipes above the water, the stem, leaf, etc., presumably on account of the floating tissues being so repellent to liquids. Especially was this difficulty found with every part of the leaf tissues, parts of which were cutinized. The loose aerating tissues of the root present no such difficulty, nor do any of the tissues of the other species. Most interesting points in the histology of this order were brought out.

The root of P. crassipes presents a beautiful structure. The cap is very large and is organically connected with the very tip of the root only, being free at its upper end (fig. 3). Goodale[6] says that this sort of a cap occurs in several species of Pontederia, and envelops the root for the length of half a centimeter. The caps of P. crassipes, however, enveloped the largest roots for 2.5^{cm} or even more. A median longisection of the root-tip shows well the connection of the cap as well as the structure of the tip itself. Hæmatoxylin

[4] Gray's Manual, 536.
[5] Gray's Manual, 536.
[6] Physiological Bot., 108.

brought out a marked differentiation just without the central cylinder, in the pericambium. At regular intervals, certain small groups of cells peripheral to the central cylinder stained a much darker blue than the surrounding cells. From their position it was judged these were the nascent tissues of the lateral rootlets, the darker staining indicating their greater activity. The mode of formation and development of the lateral roots from the mother root can be easily followed. Longisections of the rootlet coming off from various sections of the root were secured. These show the rootlet branching from the pericambium and organically connected with the central cylinder only, for a space surrounds it and separates it from the endodermis, cortex and epidermis.

Back from the tip at varying distances in different roots of the same length, but averaging about 1.5^{cm}, were noticed the beginnings of the large air-cavities. A cross-section shows the plerome cylinder surrounded by a sheath of thin-walled cells. Just without this endodermis are about six or seven rows of very regular cylindrical cells (fig. 2) forming loose tissue, with large intercellular spaces. Outside of these, between the cells of the cortex proper, occur the radiating air-cavities of varying width, traversing the length of the root.

The coloring matter of the root and root-stock, anthocyanin, imparts a dark-blue color, except for an inch or more back of the tip. It is in solution in the cell-sap of the epidermal cells only; is soluble in alcohol and is turned red by dilute acids.

The running stem bears an off-shoot at its distal end. It has aerating spaces particularly large and abundant near its periphery. The closed collateral bundles are but few in this loose region. By far the greater number are aggregated in the center of the stem, forming in mass a cylinder. The root-stock has a structure somewhat similar to that of the stem. Bundles of raphides are very abundant, especially toward the periphery, outside of the cylindrical aggregation of bundles. There was no evidence of starch being stored in the root-stock.

The leaf shows perhaps the most interesting histological structure. When the inflated petiole is cut through, large hexagonal cavities 0.5–2^{mm} in diameter are seen (fig. 4). The shining cutinized partitions are plainly visible. This loose tissue is almost impervious to water. A section placed in water shows a great deal of air imprisoned in the cavities. This inflated petiole refused to be infiltrated.

The cross-partitions, or diaphragms, are horizontal or oblique and are composed of polygonal cells, with interstitial air-spaces at the angles leading from one chamber to another. The cell walls in some of the partitions are very thick. According to De Bary[7] "air-passages in internodes, petioles, and leaves of most monocots are partitioned by diaphragms," or "stellate tissue," as it is frequently called. De Bary furthermore makes the general statement that Pontederia has diaphragms composed of many-armed cells "forming a plate with wide lacunæ." In the plates of P. crassipes, "interstitial spaces" is the more correct term for the openings between the cells, because they are of much smaller volume than the surrounding cells. True lacunar cavities occur in the diaphragms of P. cordata, however, while those of Heteranthera limosa and H. reniformis are small like those of P. crassipes. The cells of the diaphragm each have well-defined nuclei and granular protoplasmic contents, with a few starch grains. These diaphragms probably serve several purposes. Duval Jouve suggests that besides the function of allowing the passage of air, they have the office of support points for the *cross-running*[8] fibrovascular bundles. No transverse bundles, however, were noticed in P. crassipes, while in P. cordata, only in a few of the cross-plates of the smaller peripheral passages do they occur, those of the central cavity being free from them. Probably one of their principal functions is to support the surrounding parenchyma tissue and to prevent the air-passages from collapsing.

A cross section of the leaf of P. crassipes shows how admirably lightness is secured. A large air-passage usually accompanies each bundle, traversing the leaf side by side with the latter. Stomates are abundant on both sides of the leaves and on the petioles of all the species except Heteranthera graminea, the latter being submerged. The epidermal cells of each are somewhat thin-walled with the exception of those of P. cordata, which have minute tubercles on their outer walls.

The closed vascular bundles are very similar in all the species. They are surrounded usually by one layer of parenchyma cells with a large amount of bast in the phloëm and a few sclerenchyma cells opposite. Mr. Wilcox says that

[7] Comp. Anat., 217.
[8] Review in Bot. Jahres. 1: 196.

there are in P. cordata "peculiar starch cells" on each side of the fibro-vascular bundle. The "specialized cells," as he further designates them, were noticed in the petiole and leaf-bundles of P. crassipes just without the xylem portion of the bundle on either side, also an abundance of grains was seen in the larger parenchyma cells of the sheath proper (see fig. 4.). Also in P. cordata these cells were noted, with little starch or none in the larger cells surrounding. Sachs[9] says that "the reservoirs of reserve materials or organs of assimilation . . . are chiefly in that layer of parenchyma which immediately surrounds the vascular bundle." This Sachs long ago introduced into physiology as the "endodermis" and called it the "starch-bearing layer." As these "specialized cells" are part of the parenchyma cells of the "starch-bearing layer" of Sachs, one is hardly justified in designating these cells "peculiar starch cells," when their presence is the rule in all bundles. In Heteranthera limosa starch is very abundant in stem, petiole, and leaf, particularly in the parenchyma bundle sheath and the loose cells immediately about the bundle on both sides of the xylem, also in the cells of the diaphragms.

These conditions illustrate an important physiological fact, that the store-houses of food are near the highways, where it is most easily accessible. The distribution of reserve food in aquatics and the arrangement of the aerating organs is a subject of great importance. A comprehensive view of the varying conditions in aquatic plants will throw a great deal of light upon many interesting physiological problems in the life history and development of these interesting groups of plants.

In the diaphragms of P. cordata and P. crassipes are found crystal sacs containing raphides, projecting upward or downward into the cavities. Besides there are other sacs of a spindle-like shape (fig. 5.), with their longer axes placed at right angles to the diaphragm and with their middle inserted in it, so that the ends project upward and downward into the space. Each of these contains a spear-like crystal of calcium oxalate, pointed at both ends. In P. crassipes, this long kind of crystal is not so abundant in the cross-plates examined. In P. cordata, the sac attains a length of more than three times the thickness of the diaphragm. De Bary[10]

[9] Physiology, 358.
[10] Comparative Anatomy, 220.

refers to Meyen for authority for the statement that the "membrane of the sac covering the ends of the crystal ceases to be apparent, so that the latter seems to protrude freely into the air-space." None in the diaphragms of the P. cordata studied presented this phenomenon. On the contrary, it was found that all were in thick-walled sacs. In all probability, the unusual thickness of the walls partly explains the long resistance to the action of acids. Concentrated HCl applied to the section of the diaphragm slowly dissolves the raphides in one to two minutes, while the lance-shaped crystals were not completely dissolved for $1\frac{1}{2}$ hours or more, leaving the thick wall of the sac but slightly shrunken. In Heteranthera limosa, no long crystals were observed. There was, however, an abundance of raphides, especially in the small peripheral cavities of the petiole.

There was also present in most of the cross-plates of all the five species, but most abundant in P. cordata, a reddish-brown secretion in ellipsoid or dumb-bell shaped cells with very thick walls, scattered in few numbers among the stellate cells (figs. 5 and 6). Ether acts very slowly on this secretion. Preliminary experiments led to the belief that it was a gum. But, in 24–48 hours, the section left in ether showed a yellowish-brown color in the cells immediately surrounding the ellipsoidal cell, intimating the slow dissolution of the contents. Benzine acted much more rapidly in its dissolution. In all probability, the substance is a *fatty oil*, though there is room for doubt.

Among the upper row of long palisade cells of the leaf of P. cordata are many others of similar shape containing a yellowish secretion (fig. 7). These are somewhat regularly placed between the many stomates, as can be seen in a thin tangential section. Probably also in P. crassipes and H. graminea, this substance occurs sparingly. Nothing was positively determined as to its composition.

In the older stellate tissue of P. cordata, a marked peculiarity was noticed in the walls where the arms of adjoining cells met. Under high power frequently were seen one to a half dozen or more breaks in the thick wall which separates the two cells (fig. 6). In cross section, small pits were observed piercing a narrow partition. In testing for cellulose walls, concentrated sulphuric acid shrunk the protoplasm in the stellate cells, in some leaving a fine shrunken thread run-

ning from the mass into each ray of the cell. In many cases the thread held fast through the pore to that of the adjoining cell—a beautiful exposition of continuity of protoplasm.

The presence of active nuclei in the cells of the diaphragm and of starch in some, and the continuity of the protoplasm in the cells, is suggestive of these cross-plates serving a far more important function than the mere mechanical one of support. These facts indicate rather a close connection with the centers of vital activity in the plant.

New light may be thrown by such a suggestion upon the presence and regular occurrence of diaphragms in this group of plants. Some physiological experiments may further point out the real functions. It is expected that a careful study will be made of the structure of plants of allied groups and the true relationships of aquatics sought.

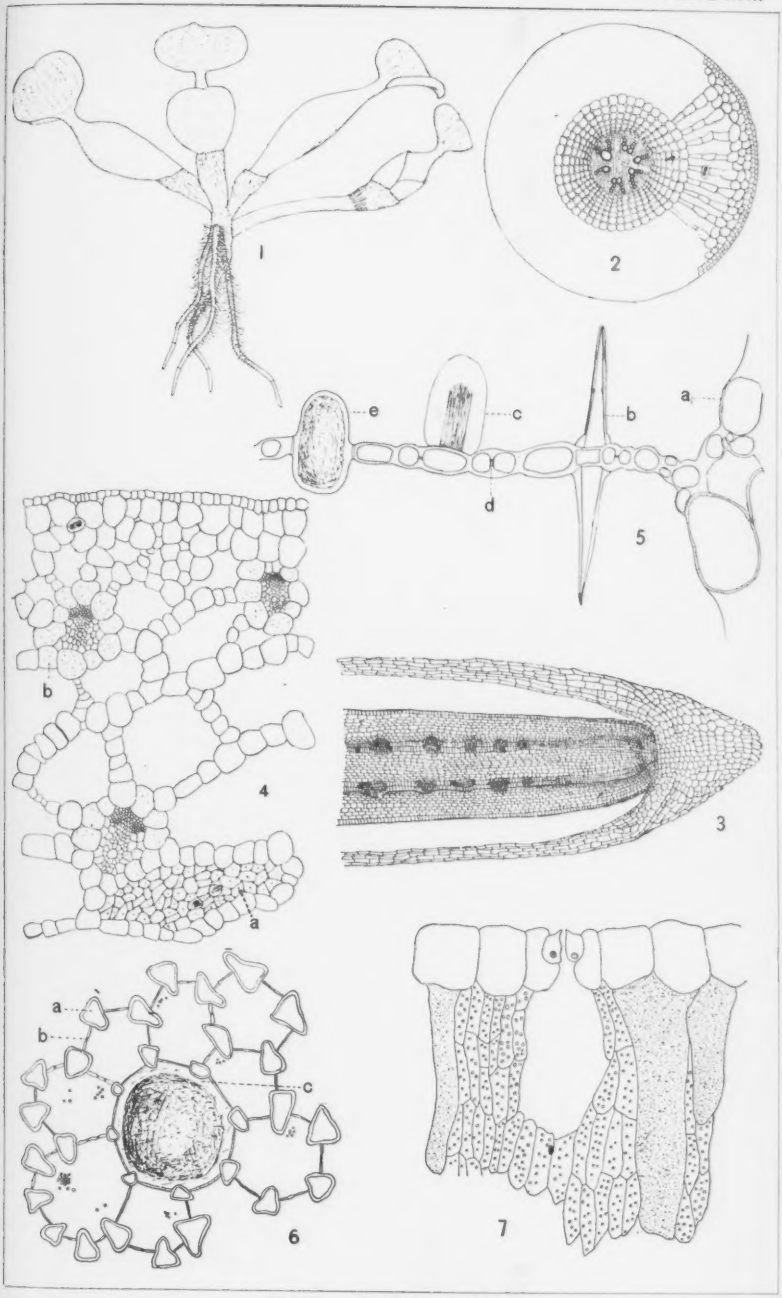
BIBLIOGRAPHY.

1. J. DUVAL JOUVE, Diaphragmes vasculiféres des monocotylédones aquatiques. Mémoires de l'Académie de Montpellier, **8**: 157–176. *pl. 8.* 1873.
2. MEYEN, Phytotomie, *pl. 5. fig. 6.*
3. VAN TIEGHEM, Ann. Sci. Nat., V. **6**: 132.
4. M. TREUB, Le méristème primitif de la racine dans les monocotylédons. Musée Bot. de Leide, **2**:—.1876.
5. F. PARLATORE, Tavole per una anatomia delle piante aquatische. Florence, 1881. Published by T. Caruel.
6. F. HILDEBRAND, Berichte der Deutschen Bot. Gesell. **1**: XXVII—XXIX. 1883.
7. L. MOROT, Recherches sur la péricyclus ou couche périphérique du cylindre central chez les phanérogames Ann. Sci. Nat., VI. **20**: 217–309. 1884.
8. S. SCHÖNLAND, The apical meristem in the roots of the Pontederiaceæ. Annals of Bot. **1**: 179–182. 1885.
9. S. SCHÖNLAND, Engler and Prantl, Nat. Pflanzenfam., II. Abth. 4. 70. 1887.
10. L. PETIT, Nouvelles recherches sur le pétiole des phanérogames. Actes S. L. Bordeaux—:1–50. 1889.
11. E. M. WILCOX, The histology of the stem of Pontederia cordata, Jour. Cincinnati Soc. of Nat. Hist., July–Oct., 1893.

Wabash College, Crawfordsville, Ind.

EXPLANATION OF PLATE XVII.

Fig. 1. A young plant of P. crassipes, showing an off-shoot. ×¼.—Fig. 2. Transection of root of P. crassipes. ×140.—Fig. 3. Longisection of root-tip of P. crassipes, showing cap and origin of lateral rootlets. ×55.—Fig. 4. Transection of inflated petiole of P. crassipes; *a*, diaphragm, with starch in the cells; *b*, starch grains in bundle sheath. ×55. — Fig. 5. Transection of a diaphragm of P. cordata; *a*, side partition of air-cavity, showing the attachment of the diaphragm; *b*, a spindle-shaped crystal in its sac; *c*, a bundle of raphides; *d*, two pits in the wall between two cells; *e*, a secretion of a fatty oil, showing manner of insertion among the cells of the diaphragm. ×350.—Fig. 6. Surface view of a portion of a diaphragm of P. cordata: *a*, an air-passage; *b*, a pit in the wall separating two cells; *c*, cell containing fatty oil. ×350.—Fig. 7. Transection of leaf of P. cordata. Upper portion of the section, showing the large cells among the palisade cells, the former filled with some secretion. ×350.



OLIVE on PONTEDERIACEÆ.

THE
JOHN CREAR
LIBRARY

Notes on Ustilagineæ.

WILLIAM ALBERT SETCHELL.

WITH PLATE XVIII.

DOASSANSIA OPACA Setchell occurs on *Sagittaria variabilis* at Providence, R. I., and at New Haven, Conn.

D. OCCULTA (Hoffm.) Cornu has been collected on *Potamogeton Claytonii* at Cold Spring Harbor, N. Y., by Mr. Thomas Morong and at Bridgeport, Conn., by the writer.

D. MARTIANOFFIANA (Thuem.) Schrœter has been found growing on the leaves of species of Potamogeton in Marl pond, Courtland county, N. Y., by Prof. C. H. Peck and in great abundance by the writer in Twin lakes, Salisbury, Conn., in a pool near North Haven, Conn., and in lake Whitney near New Haven, Conn. The species of Potamogeton have not been carefully determined for these specimens but they were certainly not *P. Claytonii* in any case.

The occurrence of D. Martianoffiana as a probably not uncommon American species is assured by these discoveries and it is to be hoped that the germination of the spores may be observed and its relationship to D. occulta more satisfactorily determined. As far as the information at present is concerned there seems to be good reason for still keeping it distinct from D. occulta. The two species have in common the structure of the sorus and similar host-plants. I have, however, never found them either upon the same species of Potamogeton or in the same locality. The presence of conidia in D. Martianoffiana as shown by Prof. Peck's specimens, as well as the difference in habit, also point towards a distinction between the two.

D. DEFORMANS Setchell has proved to be of rather wide distribution in the United States. It has been collected in Missouri by Rev. C. H. Demetrio and in South Dakota by Mr. T. A. Williams. For specimens from these localities I am indebted to the kindness of Dr. O. Pazschke and Prof. W. G. Farlow. I have also collected it near Providence, R. I., and New Haven, Conn.

Doassansia intermedia, sp. nov. — Spot inconspicuous, light-yellow to brownish, circular, one-fourth to one-half inch

in diameter. Sori hypophyllous, in the spongy parenchyma of the leaf-blade, decidedly ellipsoidal, 200–260μ long and 120–160μ thick. Outer covering of two or three layers of semigelatinized hyphæ usually present at maturity. Cells of the cortex more or less flattened, sometimes closely crowded together, sometimes more loosely placed with moderately thick brown walls. Spores globular, or nearly so, 6–8μ in diameter, in several irregular layers just underneath the cortex, not readily separable by crushing. Germination? Central portion of the cortex made up of thin-walled parenchymatous cells almost destitute of solid contents.

On leaves of *Sagittaria variabilis*. Shelburne, N. H., *W. G. Farlow!* Port Arthur, Minn., *F. W. Dewart!* August to October.

D. intermedia is the sixth member of the Doassansia group and the fifth of the genus to be found upon Sagittaria variabilis. In structure of the sorus it comes very near to the species of the subgenus *Doassansiopsis;* but instead of the spores being situated in a single regular layer underneath the cortex as they are in D. occulta, D. Martianoffiana, and D. deformans, in D. intermedia they are in several (2–5) irregular layers. Consequently it seems best to emend the character of the subgenus as follows:

DOASSANSIOPSIS.—Central portion of the sorus consisting of parenchymatous cells. Spores in one or more layers, inseparable at maturity. Cortex distinct.

D. intermedia also resembles *Burrillia pustulata* Setchell very much in general habit and structure but differs from it in the possession of a distinct cortex.

D. PUNCTIFORMIS Winter.—Niessl gave the name *Protomyces punctiformis* in 1872 to a fungus on *Butomus umbellatus.*[1] Schrœter referred Niessl's plant to the genus Doassansia as *D. punctiformis* in 1887 [2] In the meantime Winter[3] had bestowed the name *D. punctiformis* upon an Australian species inhabiting the leaves of *Lythrum hyssopifolia.* De Toni in his review of the genus[4] names *Protomyces punctiformis* Niessl, *D. Niesslii* and retains the name D. punctiformis for Winter's species. Magnus has recently[5] proposed the

[1] Verhandl. d. Naturf. Ver. i. Brünn, **10**:—.
[2] Pilzfl. Schles., 287.
[3] Rev. Myc., 207. 1886.
[4] Journ. Myc., **4**: 17, 1888 and in Saccardo, Syll. Fung. **7**: 505. 1888.
[5] Abhandl. d. Botan. Ver. d. Prov. Brandenburg, **32**: 253. 1890.

name *D. Winteriana* for the *D. punctiformis* Winter, deciding to retain Schrœter's name for *Protomyces punctiformis* Niessl.

The writer, however, has shown[6] that *Protomyces punctiformis* Niessl is not a Doassansia since the sori lack the cortex which Cornu considered the distinguishing mark of the genus, but that it is to be referred to the genus Entyloma. Consequently, the name *Doassansia punctiformis* belongs to the Australian species, of which, as Prof. Magnus kindly informs me, there is no specimen in Winter's herbarium. This prevents determining accurately whether *D. punctiformis* Winter, in turn, is a true Doassansia or not.

D. Gossypii Lagerheim.—Through the kindness of Prof. Lagerheim the writer has been able to examine specimens of this species. The sori occur in the spongy parenchyma of the leaf and are at first globular and wholly immersed. This is apparently the state seen by Prof. Lagerheim. Later however the sori break through the epidermis, the coating of hyphæ bursts open, and the spores are seen to be arranged in vertical rows, supported below upon sterile cells. The structure is not that of a Doassansia but more like that of some species of rust. The species may be referred provisionally to the genus Chrysomyxa, as **Chrysomyxa Gossypii** (Lagerh.).

Cornuella Lemnæ Setchell has been detected by the writer at Providence, R. I. and New Haven, Conn. A careful search among the dying fronds of Spirodela will probably show that it is a widely distributed species.

Entyloma Compositarum Farlow was found by the writer, growing in abundance on *Aster Novi-Belgii* at Peaks island, Maine, in October, 1889.

The spores from the fresh material germinated readily in water and gave rise to promycelia 12–17μ in length and about 2.5μ in diameter. Each promycelium produced three, four or five sporidia, which were about 15μ long, of almost equal diameter (about 2μ) throughout their length, and blunt at each end. The sporidia produced germ tubes without falling from the promycelia. No conjugation was observed but such conditions as that shown in figure 8 seem to indicate that it takes place. Spores sown from dried material in late October and in November failed to germinate.

Entyloma crastophilum Sacc. is the species to which

[6] Annals of Botany, 6: 38. 1892.

the *Ustilago lineata* Cke. is referred at present. It is a very common form near New Haven, upon the leaves of *Zizania aquatica*. The spores are dark and form elongated sori in the leaf tissue. They germinated rather freely when sown in water in May, 1892. The promycelium reached a length of from 25μ to 80μ. The sporidia were usually four in number. They do not seem to conjugate but produce buds from the distal end both before and after falling from the promycelia.

RHAMPHOSPORA NYMPHÆÆ Cunningham is described as occurring in leaves of different species of *Nymphæa* in India. What appears to be exactly the same thing has been found by the writer growing in leaves of *Nuphar advena* near New Haven, Conn., and in leaves of *Nymphæa odorata* at Ledyard, Conn., and at Woods Holl, Mass. Sowings were made in water both from fresh and from dried material but were unsuccessful.

Cunningham[7] separates this species from the genus Entyloma and makes it the type of the new genus Rhamphospora, because all the spores are borne at the tips of hyphal branches and because the promycelium is subverticillately branched.

A comparison between Cunningham's figures[8] and those of the germination of the spores of *Entyloma Magnusii* as figured by Woronin[9] and that of the spores of *Doassansia obscura* as given by the writer[10] will show that the "branches" of the promycelium are indeed primary sporidia and the fact that they do not conjugate, while the bodies produced from them do, is hardly sufficient for classifying them as peculiar structures. In many of the species of Entyloma and Doassansia the primary sporidia do not conjugate, yet there is no reason for considering them to be promycelial branches, for they arise in exactly the same way that the primary sporidia which conjugate do. The fact that these "promycelial branches" are finally septate is not in the way of their being considered primary sporidia, for the primary sporidia of many species of Entyloma and Doassansia are finally septate. The regular conjugation between what Cunningham calls the primary sporidia is peculiar but hardly sufficiently characteristic to be regarded as a generic rather than a specific distinction.

---

[7]Scientif. Mem. of the Med. Officers of the Army of India, *3*. 32. 1888.
[8]Loc. cit. *pl. 2. figs. 7–16.*
[9]Beitr. z. Kenntn. d Ustilagineen, *pl. 4, figs. 24–26.*
[10]Annals of Botany **6:** *pl. 1. figs. 37–42.*

The development of the spores has not been studied very carefully in any species of Entyloma, yet it is known that in some species at least they are subterminal as well as intercalary. Consequently, it seems best to regard this form as **Entyloma Nymphææ** (Cunningham) rather than as the type of a distinct genus.

The common barnyard grass is the host-plant of two pulverulent smuts, the one *Tolyposporium bullatum* Schrœter, the other *Ustilago sphærogena* Burrill. The distortions produced by these two species are very similar in shape and size and I was much interested to find both of them in the same locality at Woodmont, near New Haven, Conn., and even in the same inflorescence.

TOLYPOSPORIUM BULLATUM Schrœter inhabits the ovaries of *Panicum Crus-galli* causing them to swell to several times their normal size. The surface of the swollen ovary is smooth and shining and the Tolyposporium may thus readily be told from the Ustilago on the same host. It is, therefore, not a very conspicuous species, but is apparently fairly common in the New England states. The spores are agglomerated into balls and germinate readily in water at almost any season. A longer or shorter promycelium is produced and from this, sporidia bud off either terminally or laterally. Secondary sporidia are produced from these, tertiary are produced in turn, and so on until very complex branching forms result. The type of germination is of the Ustilago- as opposed to the Tilletia-group, but the germination of Tolyposporium bullatum differs very decidedly in its details from that of *T. Junci* as Woronin represents it.[11]

USTILAGO SPHÆROGENA Burrill causes distortions of the spikelets of *Panicum Crus-galli* which in size and shape closely resemble those produced by the preceding species. The more luxuriant specimens, however, reach a somewhat greater size than those of the Tolyposporium and the surface of the distortion, instead of being smooth and shining, is rough, with short, rigid hairs. This is accounted for by the fact that the upper glumes and palets as well as the ovary are infected and distorted by the fungus.

The spores are free and germinate readily on being sown in water on a slide. Sometimes sporidia were produced when the promycelium has reached a length of a few micromilli-

[11] loc. cit. *pl. 4, figs. 5–8.*

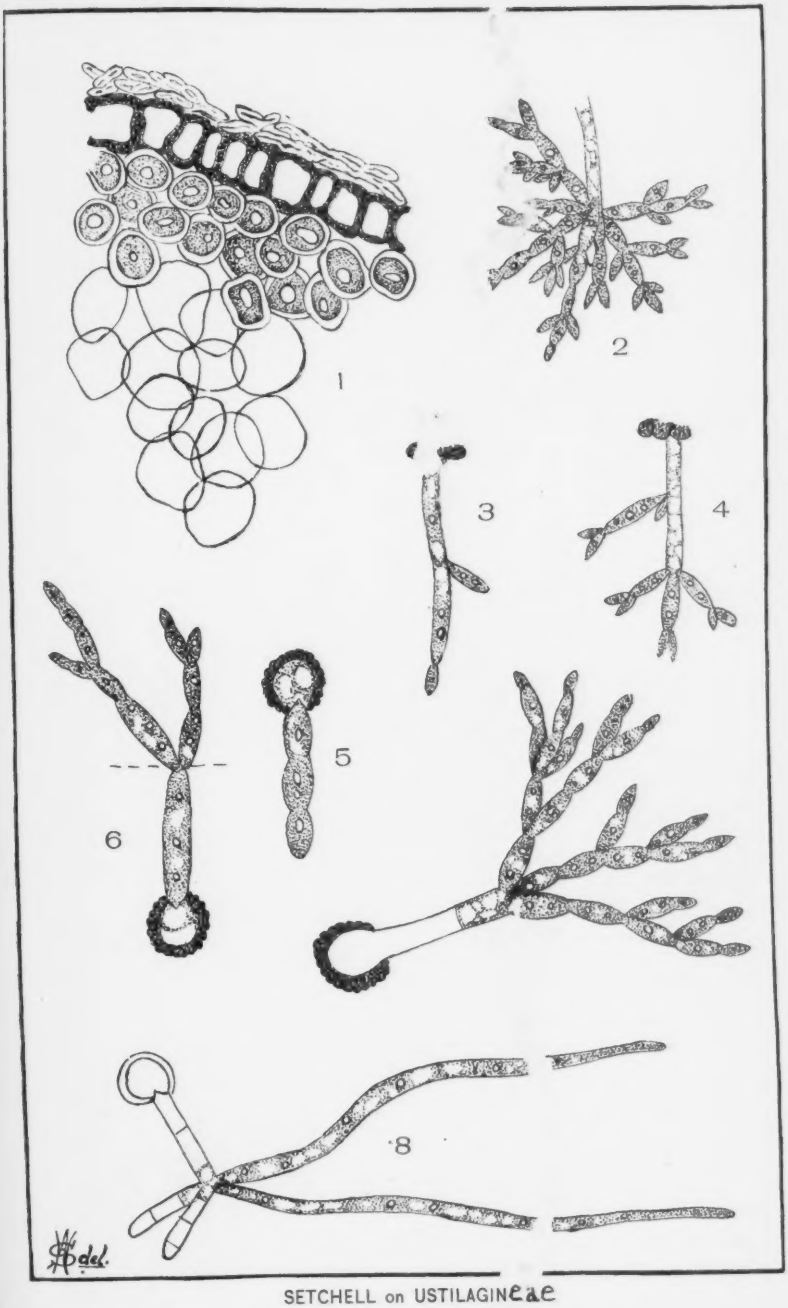
meters but often the promycelium reaches a length of from 48μ to 50μ before sporidia are produced. The promycelia grow obliquely up toward the surface of the water on the slide and some of the sporidia project above the surface into the air. On looking down upon a slide covered with germinating spores, these projecting sporidia form perfect thickets. The chains of sporidia readily fall to pieces and continue to bud until the whole slide is covered with yeast-like cells.

Germinations were obtained from sowings made in February, May and October.

Yale University, New Haven, Conn.

EXPLANATION OF PLATE XVIII.

Fig. 1. *Doassansia intermedia* sp. nov. Portion of a median section through a sorus. × 700.—Figs. 2, 3, and 4. *Tolyposporium bullatum* Schroeter. Promycelia and sporidia. × 1000.—Figs. 5, 6 and 7. *Ustilago sphærogena* Burrill. Promycelia and sporidia. The dotted line in fig. 6 represents the surface of the water. × 1000.—Fig. 8. *Entyloma Compositarum* Farlow. Promycelium with sporidia producing germ-tubes. × 1000.



SETCHELL on USTILAGINEAE

THE
JOHN CREAR
LIBRARY

The influence of mechanical resistance on the development and life period of cells.

FREDERICK C. NEWCOMBE.

(Continued from page 157.)

3. *On differentiation in the fibrovascular bundle.*—It has already been pointed out (p. 154) that the effect of mechanical resistance to extension in the tissue adjoining the growing point is to delay the differentiation of that homogenous tissue into heterogeneous. It is also true that the same cause will delay the later changes which take place normally in the primary bundles by which some of their elements are developed into mechanical xylem and phloem.

Many young stems of various species of plants have received casts about internodes at such a time that the primary differentiation of tissue had proceeded so far as to mark off fascicular from fundamental, and such internodes in their subsequent growth have fallen far behind the neighboring free parts of the stem in progressive changes in the bundles; and it must be emphasized that this delay in development is not due merely to the fact that change could not take place because no cells were formed to undergo change. It will be seen that the cells already present before casting have within the casts retained their weak condition much longer than corresponding ones beyond the limits of the cast. Vicia faba has in all cases thickened none of the xylem parenchyma cells of the primary bundles within casts and formed no secondary tissue at the time when beyond the limits of the casts not only these primary elements had been thickened but a secondary zone of mechanical xylem ten to twelve cells wide had arisen. In Althaea tauriensis every bundle outside the omits of the casts develops many thick-walled cells before line appears in the bundles within the casts. Archangelica sativa and Myrrhis odorata thicken the elements in their primary bundles and form a wide band of thick-walled secondary xylem in normal parts of their stems before a thick-walled element appears in any bundle in the part of the stem confined by gypsum. A typical preparation of this plant serves also to show the effect of the confining cast on the thickening of the walls of vessels: an average bundle within the cast had

in a radial row twelve thick-walled vessels, twenty-eight thin-walled; above the cast in the same stem in an average bundle the thick-walled vessels were forty, the thin-walled twelve. A shoot of Sambucus nigra that had grown for several weeks with a cast around one of its internodes had when examined a secondary zone of cells within the cast as well as out of it. Within the cast and a little above the cast the number of cells in a radial row of this zone was eighteen, the same in each case. But in the former only three cells had thick walls, while in the latter there were six such. Similar results to the foregoing were obtained in Urtica dioica, Dahlia variabilis and Forsythia viridissima. No contrary effect was obtained in any plant.

In experimenting on the effect of pressure on the development of thin-walled phloem into hard bast the results will perhaps be more striking, since in the plants selected the hard bast is of primary origin and the casts were not applied till the very cells destined for the fibres were present in the thin-walled condition. Hence in such cases certainly the possible factor of the interference of the cast with cell-division and so with the final result is eliminated.

In the second or third epicotyledonary internode of Vicia faba the hard bast is formed when the whole plant has produced five or six internodes. If however the internode in question is put into a cast before secondary growth begins, no hard bast is formed there till the plant has reached twice the development, that is, till about the time it blossoms. Before this time the xylem within the cast will have thickened several or many walls and outside the cast mechanical xylem and phloem will have been present four or five weeks. Two plants of Althæa tauriensis, which had grown well for eighteen days after a lower internode in each had been encased in gypsum, showed within the confined internodes only thin-walled cells, while above and below the casts hard bast was present as well as thick-walled xylem. Other individuals of the same species, which after similar treatment grew for fifty days, had begun within the casts to thicken the walls of the bast cells. Urtica dioica, grown for twenty-three days after application of casts, had within the casts no thick-walled bast, but considerable in the normal adjoining internodes. Other individuals, after growing under the same conditions of treatment as these for fifty days, had developed hard bast

of considerable but less than normal thickness. Archangelica sativa, examined after twenty days' growth with a cast around a segment of its stem, had outside the cast strong mechanical bast, inside the cast only thin-walled cells. Dahlia variabilis when grown with a cast around the stem develops hard bast outside the cast several weeks before it appears within; the same is true of Ricinus communis, Forsythia viridissima and Pterocarya fraxinifolia.

In all these plants in which the delay in the formation of thick-walled xylem and phloem has been considered, there has been an actual extension of the period between the origin of the cells and the assumption of their permanent condition. This is proved by the fact that all of the species that have been grown for a very long time surrounded by casts, and these include all those named above except Althæa and Archangelica, have shown the xylem and phloem cells slowly increasing in thickness of wall after the corresponding elements in unconfined parts of the stems had reached, so far as could be determined, their mature condition.

4. *On the time of cork-formation.*—No experiments were made directly on the formation of cork. The results are thus merely incidental and furnish no information except on the time of the beginning of cork-formation, as influenced by the enveloping casts of gypsum. Whether the influence of the casts is due to the pressure which is soon developed by the effort of the confined tissues to expand, to the protective influence of the envelope, or to some other cause is left undetermined. It seems probable, however, as will appear in the general summary at the close of this paper, that it is the pressure exerted which is the influential factor.

In all of the plants that have given results under this heading, cork-formation appears more tardily within the limits of the casts than outside. This has proved true for Forsythia viridissima which forms phellogen from the epidermis; for Phytolacca dioica and Dahlia variabilis which form phellogen from the first hypodermal row of cells; and for Melianthus major in which the phellogen appears in the innermost part of the cortex.

Effect of mechanical resistance on the permanent condition assumed by cells.

It requires no series of experiments to convince one that if a part of an organ in which primary extension is not com-

plete be so encased that it cannot grow farther, the cells must retain a smaller size than normal. The matter cannot, however, be so easily disposed of; the question of the interaction of the tissues, each striving to expand, still remains. We will consider first the effect on the division of cells; second, the manifestation of turgor between tissues; third, the definitive size of cells; and fourth, the thickness of membrane.

The results of my experiments in those cases where the material was suitable to the purpose have coincided with those obtained by Pfeffer[9] in the roots of seedlings in which he found that cells behind the growing point and in the elongating zone divided after the zone was put into a cast. The cells would thus be found shorter (but more numerous) than they were when the cast was applied. Yet this division without expansion does not progress very far, and it is only the cells that are near the stage of division before being put into the cast that divide within the cast. In cross-sections no division subsequent to the application of the cast has been found. It should be stated, however, that my preparations were not made to give, and were not often of a nature to give exact relations in this direction.

The displacement of tissues due to resistance to growth has been recorded in Aristolochia sipho by De Bary.[10] In this plant the pith is compressed by the approach of the fibrovascular bundles toward the center, the impelling cause being thought to lie in the resistance of the leathery cortex. A similar movement of the fibrovascular bundles toward the center has been induced in many of my plants by the resistance of the cast. The conditions for this displacement are that the gypsum must be laid around the stem before the fibrovascular zone has formed a bridge of mechanical tissue, that the pith contains intercellular spaces or has lost the most of its turgor, that the cortex is in an active condition and does not possess large intercellular spaces. Thus the pith has been compressed in Vicia faba, Urtica dioica, Archangelica sativa, Myrrhis odorata, Curcubita pepo, Melianthus major and Ricinus communis. When such a displacement of tissues has taken place, the pith is more or less distorted or crushed; the elements of the bundles are radially elongated and the vessels generally collapsed; the cortical cells are radially elongated and often assume the shape of palisade cells.

[9] Pfeffer: Druck und Arbeitsleistung, 127.
[10] De Bary: Vergleichende Anatomie, 549.

The explanation for these changes is not difficult to find. The pith is the nearest of any tissue to the close of its growth and has the smallest turgor. The cortex is at the stage of its most rapid extension, and every cell dilates in the direction of least resistance. The young bundles grow also, but the amount of their extension is much less at this time than that of the cortex, consequently they do not check the inward pushing of the latter but are carried by it in against the pith whose cells are thus crowded closely together. This movement continues till the intercellular spaces are filled, or till the pre-existing pith-cavity is closed up, when an equilibrium is established and the cortex grows no farther. Displacement does not always end here, however, for the force of growth in the primary or secondary meristem of the vascular ring may prove sufficient to crowd back the cortical cells, often causing them to show wavy walls and in some plants, as Ricinus communis and Eryngium planum, actually crushing them.

The foregoing paragraph furnishes the key to the understanding of the definitive size attained by cells of various tissues when the resistance to growth is made effective before primary extension has ended. Thus although the cells retain longer than in normal growth their capability for extension, they must of necessity reach a time when that capability is lost. With a stem within a cast the pith-cells generally are found to use the least of any tissue the room for extension furnished by the intercellular spaces. The size which they attain relative to their normal size is very nearly the same which they had when the gypsum was laid around the stem. Thus in Archangelica sativa, which had been encased when young, the pith-cells were found to have one-half the diameter of those above and below the cast, though none of these cells had divided meanwhile. A similar result with a varying proportion in the size was obtained in all the plants experimented with, ten species in all.

Precisely similar results were found in the cells of the cortex, except that they nearly always expand more within the cast than do the pith-cells. In the cortex, however, the power of growth is retained both normally and within casts so much longer than in the pith that there were but few of the plants under experiment that showed cortical cells in their definitive condition. It is true, nevertheless, that the

definitive size of these cells would be the same as that possessed several weeks after the application of a cast, for in that period the cortex has reached the full extension allowed by the circumstances and any subsequent expansion will be confined to the bundles. In this case, then, we may reckon the size of the cortical cells after the cast has been around the stem for several weeks as the definitive size; whence it follows, that, like the pith, the cortical cells will reach their definitive state with longitudinal and cross-diameter much less than in normal growth.

De Vries and Krabbe in the writings already cited record the fact that the elements of the xylem, when growing under strong external pressure, will not attain their normal size. My experiments have confirmed this result in every plant used. The difference between the size attained and the normal size differs in various species. In Eryngium planum it was found in one plant to be as two to three; in one plant of Pterocarya fraxinifolia as one to two.

Not only the xylem part of the bundle produces elements of smaller size but the phloem also; though a smaller size for the cambium cells could not be demonstrated. These Krabbe found in his experiments to retain their normal size under all pressures; and it will be remembered as already cited in these pages that Pfeffer found the size of the meristematic cells of the growing points of roots and stems to be unchanged when growing in gypsum casts.

Regarding the ultimate thickness of membrane attained by cells growing against pressure, it may be said that the thickness of wall in undifferentiated fundamental tissue does not seem to be decidedly affected. There are many cases known where the cortical cells, for instance, some time after elongation has ended, thicken up their membranes considerably. Such membranes have in my experiments never been found to become thicker within the casts than normal, nor do they seem to remain much thinner. It is to be understood here that in this group of experiments the casts were applied when the stems were very young and while fundamental tissue was in its primary thin-walled condition; the subsequent differentiation into mechanical cells is not referred to, but only the even thickening of the parenchyma as it assumes its definitive condition. This thickening seems to progress within the cast as well as out of it though the cells within

may come far short of attaining their normal dimensions. As soon, however, as the development of mechanical cells be considered, we shall find, as will soon be pointed out, a profound effect produced by the cast. It must be indicated in this place that the question that has just been discussed—the influence of pressure on the thickening of the walls of fundamental parenchyma—may not be answered for every plant by my experiments. In all of my plants the normal thickness attained by this tissue is slight and hence a small variation caused by the cast would be difficult to distinguish. It is possible that in plants in which the fundamental parenchyma forms thicker walls than those used in my work, the effect of casts would be apparent in preventing the normal increase in thickness. It is not at all probable, however, that the opposite will be found true, i. e., that cells will form thicker walls than normal when pressure prevents them from attaining their full size. Precisely this assumption was, however, made by Wortmann.[11] He wound the stems of seedlings with twine and found upon examining them after they had been in these bandages for several days, that the cortical cells had thicker walls than normal. This result, it need not be said, seems contradictory to all of mine obtained by the use of casts. It can, however, I believe, be reconciled.

In the first place, it makes a great difference whether the growth be confined by a twine bandage or by a gypsum cast. In the former case the peripheral cells grow out between the strands, producing considerable distortion always accompanied by a good increase in the thickness of neighboring cell-walls. This has been demonstrated by my experiments on Ricinus communis and Phaseolus multiflorus, the latter being one of the plants used by Wortmann. When these plants, however, were encased in gypsum, no such distortion occurred, nor were any cell-walls, as Wortmann found them, greatly thickened, the same result that a dozen other species of plants have given.

In the second place, the first evident effect of confining the extension of young tissue is the closing up of intercellular spaces. The result is a collenchymatous tissue; for at the angles of the cells the two layers of the membrane are appressed and although the thickness has actually nowhere increased, one must look carefully to escape deception.

[11] Wortmann, Beiträge zur Physiologie des Wachsthums. Bot. Zeit. **47**: 286. 1889.

In the third place when tension is induced within tissues a thickening of the cell-membrane follows.[12] This is shown slightly in some plants in which the cortical cells elongate toward the center of the stem after the application of a cast. It is still more apparent when within a cast a few cells of the cortex die and the neighboring cells crowd in to fill the space. It is shown also in all my preparations at the limits of the casts where great tension has arisen between the confined segment of stem and that portion just outside the cast that is striving to expand.[13] All these cases, however, lie outside the question as discussed by Wortmann.

If now we return to the particular case of Phaseolus multiflorus, each of several individuals has shown that the peripheral cell-walls are much thickened where the coils of the twine bandage have caused distortion. In this plant also there are large intercellular spaces in the cortex at a very early age even before the elongation of the hypocotyl is completed. The bandage of twine or gypsum causes these intercellular spaces to be closed within a few days and as a result there is at the angles of the cells a double thickness of wall, merely an *apparent* thickening. There was only one case in which there seemed to be a possibility that the cortical cells had abnormally increased in thickness of membrane within the cast. Here these cells had elongated considerably toward the center of the stem, and if the membranes were slightly stronger the change would probably be accounted for by the tension called forth. But in this plant it is not certain that the membranes had so thickened; since they were no thicker than sometimes found in very young normal individuals. It can at least be said that Phaseolus multiflorus furnishes no illustration of Wortmann's theory that membranes increase in thickness more than normally when their full extension is prevented by mechanical means. All of the plants used in my experiments have contributed to an opposite conclusion. Moreover, Pfeffer, in his experiments with roots and stems of seedlings, noticed no unusual thickening within the segments enclosed in gypsum.

The outer pith-cells in many of the species recorded in this article become normally thick-walled to such an extent that

[12] Hegler's work as reported by Pfeffer, Berichte d. k. sächs. Gesellschaft der Wissensch., demonstrates the fact that tension increases mechanical tissue.

[13] For details in these experiments see Newcombe: The effect of mechanical resistance on the growth of plant tissues. Leipzig, 1893.

they pass into mechanical tissue. In no plant have these cells shown thicker walls within than without the casts, and where it can be determined that they have reached their definitive condition they are thinner walled within the casts than normally. Vicia faba and Melianthus major have illustrated the truth of the last statement. In these two plants, the stem, after being confined for several weeks within gypsum, was released and grew for weeks afterward. When sections were made the outer pith-cells were found thinner-walled than normal, though they had reached their definite condition. That they had reached their definite condition was determined from the examination of several individuals at different ages, and thus the time when development ceased could be inferred.

That the xylem elements remain definitely thinner-walled when growing under pressure was determined by Krabbe *(l. c.)* for trees. None of my plants have indicated a contrary result and the two species in which it could be certain that the definitive condition had been reached corroborated Krabbe's view. Melianthus major and Vicia faba have each in several instances been released from casts and allowed to grow subsequently. The xylem elements that had been formed while the casts were present could be easily distinguished by their thinner walls from those formed subsequent to the removal of the casts.

(To be concluded.)

University of Michigan, Ann Arbor.

BRIEFER ARTICLES.

Notes from Vermont.—In January last, while looking over some ferns at the Vermont Agricultural College, I noticed some very fine large specimens which did not look like anything I had ever seen before. On closer examination they proved to be *Dryopteris* (Aspidium) *marginale*, but the fronds were tripinnatifid. I sent a specimen to Prof. Underwood and he tells me that he never saw a like development of this species. These specimens were collected by C. E. Stevens, at Colchester pond, near Fort Ethan Allen, which is also the only Vermont station for *Woodwardia Virginica*.

Myriophyllum scabratum grows in abundance in a little pond in Johnson, Vermont. This is 200 miles farther north than before reported.

Mt. Mansfield is well known as a locality for rare mosses but I can find no account of *Tetraplodon mnioides*, as coming from this locality. I collected this in the summer of 1893 on the skeleton of a hedgehog, in the swamp back of the Summit house. *Aster tardiflorus* was collected in Smuggler's Notch, in the summer of 1893, being another rare plant to add to the long list from this locality.—A. J. GROUT, *Johnson, Vermont.*

Other poisonous plants.—The note by Dr. Harshberger in the April GAZETTE leads me to state that at least two other plants, perhaps not recorded as so endowed, produce in some cases an irritation or poisonous effects, namely: the Osage-orange (*Maclura aurantiaca*) and the star-cucumber (*Sicyos angulatus*). A friend of mine informs me that in working in the maclura hedges he has suffered considerably and when the thorns pierce the skin they seem to leave a poison in the wound.

Another friend has been repeatedly poisoned in handling the star-cucumber. To me the plant is unpleasant to the touch, and particularly the burr-like fruit, but it has never left any well-defined inflammation. Ordinary field barley, however, is extremely unpleasant to the writer, and when an awn is drawn across the wrist, for example, it will leave a line of redness for hours.

Some truckers, I have learned, are affected by celery, and after working in it for a few days the hands become quite swollen. The celery belongs to a family of which many members are poisonous.

Some species of greenhouse aloes are also reported as causing inflammation when the juice is applied to the skin.—BYRON D. HALSTED, *Rutger's College, New Brunswick, N. J.*

EDITORIAL.

MANY BOTANISTS in the United States have felt that the time has come when it would be profitable to make a compact and complete presentation of the North American flora, so far as it is known. It is thought that such a work will make information so accessible that study will be stimulated and knowledge developed much more rapidly. Such a work does not represent the end of investigation so much as a foundation for its more vigorous prosecution. It is with this purpose that certain botanists now announce that arrangements have been perfected for the publication of a "Systematic Botany of North America." The work is to be under the editorial control of Messrs. Atkinson, Britton, Coulter, Coville, Greene, Halsted, Hollick and Underwood; and they have already announced the co-operation of at least thirty more of our best known botanists. It is the intention to invite the largest possible co-operation, in order that the work may be so subdivided as to make its completion possible within a reasonable time. The work is to appear in seventeen volumes, with about five parts to each volume and 100 pages to each part. There will be no illustrations, but full references will be made to published figures. Special features will be the examination of type specimens, the citation of type localities, geographical distribution, and a discussion of the economic, palæontologic and horticultural features of each order. The general sequence of orders adopted is that of Engler and Prantl in "Die natürlichen Pflanzenfamilien," and just as in that work, parts of all volumes may be printed simultaneously. A uniform style of presentation and a consistent nomenclature will be adopted, but each monographer will be responsible for his own matter. It is hoped that five or six parts will appear annually, beginning with 1895.

We cannot but feel that this large undertaking marks an epoch in the history of systematic botany in North America. To attempt to present the complete flora of a great continent in so short a time means great activity and extensive organization, and the large response already obtained testifies to a fine fraternal feeling among American botanists. In the very nature of things such a work will be uneven, but the unevenness will be no more noticeable than that of our great cyclopædias. There can be no doubt that in the course of preparation it will also develop many new investigators of our varied flora. We bespeak for the work the widest co-operation, that it may be made a fit monument to the zeal and industry of American botany and a notable datum-line from which subsequent advances can be more rapidly made.

CURRENT LITERATURE.

A text-book for advanced students.

It was with pleasure increasing page by page that we read Dr. Vines' latest book[1] which is intended as a general survey of the whole field of botany with suitable presentation of its salient features for students. Finding it necessary to revise the English edition of Prantl's *Lehrbuch der Botanik*, Dr. Vines wisely decided that it would be better, while retaining the form of the previous book, to extend it sufficiently to make it suitable for advanced students. This meant complete rewriting. The first half of the book was issued by the publishers in January, in response to numerous requests, and the second half, treating of the classification of seed plants and of physiology, is promised within the year.

The portion before us treats of the morphology, the anatomy and histology, and the classification of plants through the pteridophytes. The first of these topics was the one most in need of thorough and logical treatment, having in mind all members of the plant kingdom, and it is gratifying that it has received just such treatment.

It is really refreshing to have the special morphology of plant members discussed in such a broad and consistent way as Dr. Vines has done. We have long felt that the discussion of these matters in even the best books was obscured by the constant reference of structures to an arbitrary phanerogamic norm. It is beyond doubt that the terminology in common use has been contradictory and confusing to the last degree, largely because we have approached the simpler plants from the direction of the most complex ones. No one book can hope to work a revolution either in ideas or terminology, but this one has wrought out ideas for the most part logically and consistently. In the matter of terminology there has been as little change as possible, we think, consistent with the statement of modern views of homology. Yet to those who are unfamiliar with these homologies and the changed terms already proposed we can well understand how the book would seem almost revolutionary in this respect. Indeed this *has* been made the basis of severe criticism in the *Journal of Botany*.

We observe with gratification that Dr. Vines has abandoned his earlier usage of the words *dorsal* and *ventral* as applied to a leaf, which was the reverse of their ordinary application. This recalls the disap-

[1] VINES, S. H.—A students' text-book of botany (first half). 8vo. pp. x + 430. Figs. 279. London: Swan Sonnenschein & Co. New York: Macmillan & Co. 1894.—*7s. 6d.*

proving snort with which Dr. Gray accompanied his pointed comment as he glanced over the preface of Vines' *Physiology* where an explanation of the usage to be followed therein was given: "Humph! if a man wants to call the belly the back and the back the belly I suppose there is no way to prevent it!"

In the discussion of anatomy and histology the author has followed the older lines more closely, too closely, perhaps. In the classification of the tissues, we had a right to expect the abandonment or subordination of the three tissue systems of Sachs and De Bary, which rest mainly on the course of early development and obvious but superficial anatomical relations. This is the more striking since the retention of these tissue systems is scarcely consonant with the adoption of the *stele* as a morphological unit, a step which we think eminently good. Neither is the treatment of the sclerenchyma and sclerotic parenchyma as modern as it might be to its betterment.

Without going into details regarding the third part, the classification of plants, we may say that while we do not think well of Dr. Vines' great divisions (e. g., we cannot agree that Thallophyta constitute a group in anything like the sense in which the Bryophyta and the others do), we especially like the mode of treatment he has adopted, wherein he seems to have chosen the golden mean between overmuch detail and unintelligible generalities.

As a final word we commend the book most heartily to American teachers for the use of advanced students, for whom Goebel's *Outlines* and De Bary's *Comparative Anatomy* were too detailed, too special, and too costly. Here is a work which will serve as the text-book accompanying laboratory courses in general morphology, in histology and in physiology (when the second half appears).

We wish that the publishers would issue the work not only in a single volume, but also publish parts I and II, part III, and part IV (when ready) independently, forming thus three small volumes which might be purchased separately. This would, we are sure, vastly stimulate the sale on this side of the water and be of decided convenience to students. For the manufacture of the book we have only praise. Paper, press-work and binding are all good, and the price (of this half) is low.

Two laboratory manuals.

Teachers and students can hardly claim that there is no choice of laboratory manuals, as the number of these helps is rapidly increasing. Every teacher of botany, however, has his own notions, and the probabilities are that such books will continue to be written till they are as

numerous as the teachers. A late publication of this kind is that of Mr. E. R. Boyer,[1] instructor in biology in the Chicago schools, and his book is intended to stand for the work in biology in these very important secondary schools. The book is primarily intended for those schools that wish to offer a year of continuous work in a biological combination of zoology and botany, a thing which we do not believe in, but which is common enough. The greatest step is taken when secondary schools depart from text-book and "analysis" and seriously engage in laboratory work; and the next step in advance is taken when the plant kingdom is presented as a whole. Both these steps are taken in the book before us, which cannot, therefore, be other than helpful. Its further usefulness will depend upon the training of the teacher and the selection of proper illustrative material. That "the inductive method" demands better trained teachers than secondary schools ordinarily possess is unquestionable, but this is no fault of the method. As to the selection of material in the present book, the series of animal types is placed first and not intercalated with plant types, a thing to be commended, although we question the practicability of making the very first exercise a study of Amœba, a thing that no instructor can have time to find for a large class and no beginner can find for himself. The botanical series is much shorter, as it always is in these combination guides, and is made up of Protococcus, Saccharomyces, Spirogyra, Vaucheria, Chara, Marchantia, Pteris, Pinus sylvestris, Trillium recurvatum, and seed studies of bean, corn and pine. We certainly question the omission of all fungi and mosses, especially when the list includes Chara and Marchantia, which are hardly typical of anything excepting themselves. With properly trained teachers, however, the book can hardly help working a revolution in the Chicago schools.

An "Elementary Practical Biology" is the title of an introduction to zoology and botany by Prof. Chas. W. Dodge of the University of Rochester.[2] In plan the author combines to some extent the scheme of Sedgwick and Wilson with that of Huxley and Martin. The work begins with the examination of a drop of stagnant water. He then takes up the study of the cell as seen in one-celled animals and in the tissues of higher animals. A similar study is made of vegetable cells, and this is followed by the study of a series of animals beginning with

[1] BOYER, EMANUEL R.—A laboratory manual in elementary biology, an inductive study in animal and plant morphology. Designed for preparatory and high schools. Small 8vo. pp. xiii + 215. D. C. Heath & Co., Boston. 1894.

[2] DODGE, CHAS. W.—Introduction to elementary practical biology, a laboratory guide for high schools and colleges. 8vo. pp. xxiii + 422. New York: Harper & Bros. 1894.

the sponge and ending with the frog. A similar series of plants is studied from vaucheria to the flowering plant. In the list of plant types it is difficult to discover the principle of selection. Why the blue-green algæ, the red algæ and the mosses should be omitted when Chara and Protococcus are given a place is not apparent. Yeast, penicillium and the mushroom can hardly be said to represent the fungi, nor do their life histories compare in biological interest with those of the rusts, peronosporas and lichens. The types chosen are all familiar figures in the positions they occupy but the list can hardly be said to be up to date from the standpoint of the botanist. The book contains an abundance of material to meet the wants of any school. The directions for dissection are given in the form of questions which are suggestive and stimulating and lead to the latest and best methods of making and exhibiting the more difficult anatomical preparations.

As a manual of dissection the book is a success, but as an introduction to biology it is certainly open to criticism. A number of physiological questions and experiments are introduced after the dissection of each type but the organism is always approached and chiefly studied from the standpoint of the anatomist. For the beginner certainly the working out of anatomical details is chiefly of interest and importance as it bears on the solution of problems of function. A dissection should be so planned as to lead the student to group the facts discovered as bearing on this or that problem in physiology. Details of structure which can not be readily so grouped are of secondary importance in the first year's work in biology.

The chapter devoted to the flowering plants departs from the plan of the book without being an improvement. It is a composite of studies in seeds, stems, buds and flowers of all sorts, with experiments in germination, transpiration, etc. Such studies are of course very useful and interesting but they should certainly be preceded by a study of the life history of some one flowering plant. It is as if the author had substituted for his very comprehensive and thorough dissection of the frog studies on the heads, legs, muscles, etc., of a dozen vertebrates taken more or less at random.

An appendix contains a well selected list of reference books arranged according to the list of organisms studied and descriptions of the more common reagents and their uses.

The typography and general make up of the book are excellent.

Agricultural Botany.

The subject of agricultural botany is a difficult one to treat. There is no well defined range to it. Usually it is made to include the ele-

mentary part of all departments of botany, with portions here and there expanded and illustrated to meet the special problems in agriculture. Occasionally a work is made to cover only those features of the science which specially affect agricultural practice. Really good examples of the latter form have not yet appeared in English, although a demand may be expected to arise eventually from our numerous agricultural colleges, if not to some degree already existent.

We believe that the subject matter of a work, which can justly bear the title of "agricultural botany," should be almost entirely, or even wholly, devoted to facts and problems of special interest to the agriculturist. Yet we are aware that many schools, even some agricultural colleges of high rank, do not provide a course in botany sufficiently full for the student to obtain, as he should do, a good foundation in the morphology, anatomy, classification and physiology of plants before entering upon the more special and more detailed study of the plant life as exhibited under the hands of the cultivator. There is a demand for a work of moderate compass at once elementary and expanded upon topics having a practical trend, that is, for a book both general and special, a vade mecum, a short cut to specialization.

The recently issued volume by Mr. M. C. Potter[1] covers this requirement most admirably, since it is well printed, well bound, abundantly illustrated, of handy size, covers a wide range of information, is carefully written, and contains useful matter. The thirteen chapters deal respectively with the introduction, cell, root, leaf, stem, flower, fruit and seed, food, reproduction, diseases, grasses, Leguminosæ, and classification.

The attempt to write for the comprehension of the wholly uninformed in botanical matters, while giving the latest results of research and the most recent views upon unsettled problems, often interferes with a smooth and dignified presentation.

There is little in the work that is novel either in subject matter or method of expression; it is not materially better or worse than many other treatises upon the elements of the science, except an advantage from being a recent publication. It gives another text from which to choose, particularly for the use of classes. It is certainly too much to expect that any farmer, unless he be a recent college graduate, can make much use of such a book.

After granting that the author has made a fairly wise selection of matter for his work, there is little to criticise. The use of the singular form of the word stoma in place of the plural on pages 45–52 may be

[1] POTTER, M. C.—An elementary text-book of agricultural botany. 12 mo. pp. 250. figs. 99. London: Methuen & Co., 1893.——3*s.* 6*d.*

assumed to be an oversight. The chapter on diseases is very inadequate, and betrays a lack of knowledge of the great advances recently made in this line of study, especially in America. And one is justly suspicious of superficiality in a writer who uses the misnomer "fungoid." The first chapter contains the common attempt to show antithesis between animals and plants. The author in saying that "the plant, if supplied with the various elements required for its structure in the form of mineral matter, can perform all its various functions," etc., while "the animal, on the other hand, requires that all its food should be presented to it in the organic form," forgets or ignores for the time being that more than one fourth of all known species of plants (fungi) are as dependent upon organic food as are animals. Indeed, the fact is recognized a few pages further on, where the author says in another connection that "the fungus, in the manner of obtaining its food, resembles an animal in so far as it can only live on organic matter." How long must it be before writers will be able to forget the old fallacy of opposite characteristics in animals and plants, and come to recognize the unity of the organic world, and emphasize the correspondences rather than the antagonisms?

Botanical Classics.

Wilhelm Engelmann of Leipzig, to whom the botanical world is already greatly indebted for bringing out numerous standard treatises, has undertaken the publication of a uniform series of the most important of the older standard works of science under the general title of *Ostwald's Klassiker der exakten Wissenschaften*, to include works upon mathematics, astronomy, physics, chemistry and biology.

The last issue of the series is Sprengel's "Mystery of nature disclosed in the structure and in the fructification of flowers."[1] It is issued in four small handy volumes, well printed, bound in leatherette, and admirably adapted for perusal or ready reference.

The fourth volume is given up to the plates, which are remarkably well reproduced, although somewhat smaller than the originals. The works are issued at such a low price, and in such an attractive form, that they should greatly stimulate acquaintance of the present generation with the early masters of the science.

The recent centennial anniversary of Sprengel's discoveries makes the general value of his writings well known to all; and this publication gives an opportunity to become familiar with his own words.

[1] SPRENGEL, CHRISTIAN KONRAD.—Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen (1793). 4 vols. 12 mo. pp. 184+172 +180+7. 25 pl. (Ostwald's Klass. d. ex. Wiss., Nos. 48, 49, 50, 51.) Wilhelm Engelmann, Leipzig, 1894. M. 2 per volume.

OPEN LETTERS.

A criticism of the "Synonymy of Juncodes."

Having been especially interested for the past few years in a critical examination of the order Juncaceæ, and my attention having been drawn to a recent article by Mr. E. P. Sheldon, entitled, "Synonymy of the North American species of Juncodes,"[1] I desire to criticize this paper because it seems a fair sample of a current class of manuscripts which should *not* be published. Its author having in view a revision of the genus Luzula, or Juncoides, and finding the current nomenclature in an unsatisfactory condition, has proceeded, properly, to make a list of the species, preliminary to his future study of the group. But going further he has published the list in this early stage of its development, before it has been tested by a close examination of either literature or specimens.

The name of the genus was first printed *Juncoidès*, not *Juncodes* as quoted by Mr. Sheldon, and was used first by Dillenius in 1719, not by Mœhring in 1736. After the date 1753, adopted by the Genoa Congress as the starting point for our nomenclature, the genus was first characterized by Adanson, who spelled the name *Juncoides*. At least two of the binomials inserted here as new have already been published, and some of the other names can not properly be maintained. The synonymy cited is the same as that given in the last monograph of the Juncaceæ, published in 1890, by Buchenau, he however retaining the Decandollean name Luzula. Since, therefore, the generic name is wrong, since some of the names proposed as new have already been published and others can not be maintained, and since the synonymy may be consulted in an excellent monograph only four years old, the list can not add to our present knowledge of the group any information of material value, and it is only to be regretted that its author did not confine it to its legitimate use, that of a manuscript aid to critical study.

At this time, in the absence of any standard book or check-list of American plants in accord with our system of nomenclature, there is a tendency among active botanists for each to prepare lists of his own, and I have called attention to the present paper only because it is a fair illustration of the undesirable result of publishing such lists when the results are not verified by critical study.—FREDERICK V. COVILLE, *Washington, D. C.*

---

[1] Geological and Natural History Survey of Minnesota. Bulletin no. 9. 62–65. 1894.

NOTES AND NEWS.

MR. AND MRS. T. S. Brandegee have removed to San Diego, taking with them their botanical library and herbarium.

WITH THE CURRENT number (March) of *Zoe*, completing the fourth volume, it is announced that its publication will cease for the present.

IN THE Bulletin of the Iowa State Board of Health, **7**: 9, J. Christian Bay gives a brief account of bacteriological work in medical science.

PARASITISM OF Nostoc and Chlorococcum upon Gunnera is treated by B. Jönsson in an illustrated article in the *Botaniska Notiser* for 1894, pp. 1–20.

THE MORE extensive use of pith in hand and microtome sectioning is pleaded for by Dr. Alfred C. Stokes in the February number of Queen's *Microscopical Bulletin*.

DR. THOMAS MORONG, curator of Columbia College, died on Thursday, April 26th. A sketch of his life and botanical work will appear in the next number of the GAZETTE.

DR. DOUGLAS H. CAMPBELL, of Stanford University, expects to sail for Europe early in June to be absent six months. He has in preparation a general work on the archegoniates.

MR. F. H. KNOWLTON has published in Bull. 105, U. S. Geol. Surv., an annotated list of the fossil plants of the Bozeman (Montana) coal field, with a table of distribution, and descriptions of new species.

MR. ERWIN F. SMITH is editing a very interesting department of *Science* under the title "Memorabilia Botanica," in which matters of current interest and publication are presented in a full and attractive way.

THE SPECIES of Isoetes of central France are characterized by M. l'Abbé F. Hy in *Journal de Botanique* (March 1). The three sections are represented as follows: Aquaticæ, three species; Amphibiæ, seven species; Terrestres, two species.

MR. HERBERT L. JONES will have charge of the summer course in botany at Harvard next summer. The only course offered is one in "phanerogamic botany," which means the general morphology and classification of flowering plants and ferns.

AN ENUMERATION of the fungous flora of Portugal by P. A. Saccardo (Boletin da Sociedade Broteriana, **11**: 9–70. 1893) gives a total of 1,178 species, of which the four groups of Agaricineæ, Sphaeriaceæ, Sphaeropsideæ and Hyphomyceteæ embrace nearly two-thirds.

A NEW DIVISION, the Division of Agricultural Soils, has just been created in the U.S. Department of Agriculture, as a part of the Weather Bureau, with Prof. Milton Whitney in charge. It is proposed to make a study of the relation of soil to crops and of soil physics.

BOURQUELOT has found[1] that *Aspergillus niger*, when cultivated in a fluid medium to maturity, excreted a considerable number and variety of enzymes. Invertase, maltase, trehalase and inulase act on sugars; diastase on starch; emulsin on glucosides; and trypsin and pepsin on proteids.

PROFESSOR L. H. PAMMEL, of Ames, Iowa, has published some "Notes on the flora of Texas," being an account of the flowering plants noted in central Texas during a visit in the summer of 1888 and 1889 while engaged in studying the "root-rot" of cotton. The list contains 291 numbers.

THE EXPERIMENT STATIONS of Europe are being described in a series of illustrated articles in the *Experiment Station Record*. The station at Bernberg, famous for the work of Dr. Hellriegel upon the assimilation of free nitrogen by the Leguminosæ, and kindred subjects, is the last one treated.

WE ARE informed by Dr. W. Thornton Parker, in *Science* (Feb. 23), that "the loco-plant is regarded by Professor Gray, of Harvard University, as the *Astragalus legum*, a peculiar species of the Vetch tribe, abundant in the region of the 'Texan Panhandle.'" We wonder where Dr. Gray made such a statement!

AMONG Messrs. Swan Sonnenschein & Co.'s announcements for the spring of 1894, we note the Handbook of Systematic Botany, by Dr. E. Warming, Professor of Botany in the University of Stockholm, to be translated and edited by M. C. Potter; Flowering Plants, by James Britten; and Grasses, by W. Hutchinson, the two latter in the Young Collector Series.

THE QUARTERLY BULLETIN of the University of Minnesota has reached the first number of its second volume. The last issue contains a half dozen botanical papers. All but one, a preliminary note by Prof. Conway MacMillan on the casting off of parts of the aquatic hairs of Azolla, are résumés of articles published in different serials and already noticed in these pages.

A NEW "sand plum" from Kansas is described and figured by Professor Sargent in *Garden and Forest* (April 4). It is named *P. Watsoni*, from Dr. Louis Watson, of Ellis, Kansas, brother of the late Dr. Sereno Watson, by whom the seed was sent. The plant has been growing in the Arnold Arboretum since 1880, and has been mistaken by travellers in the west for P. angustifolia. It is abundant on the banks of the Saline River.

IN THE *Am. Micr. Jour.* J. Christian Bay is publishing a series of papers on the study of yeasts. The February number has descriptions and figures of the Hansen culture box and of a new infection needle. A description of the latter also appears in *Ber. d. deutsch. Bot. Gesells.* 12: 1. 1894. The same number of the *Journal* also contains a paper on the aeration of tissues and organs in Mikania and other phanerogams, by W. W. Rowlee.

FOR MAKING microscopical preparations of algæ which preserve

[1] Bull. Soc. bot. de France **40**: 230. 1893. Cf. Bot. Cent. **57**: 200. 1894.

their structural characters unchanged, Lemaire proposes[1] the following method: Fix in a saturated watery solution of uranic acetate, with 0.3 per cent. chrome alum for 6–12^h; wash thoroughly; transfer to slide into two or three drops of 10 per cent. glycerin (in water); concentrate by evaporation of water under bell jar with $CaCl_2$; mount in Kaiser's glycerin jelly or Behrens' ichthyolglycerin.

Miss Anna Murray Vail has published in *Bull. Torr. Bot. Club* (March 24) the result of a study of *Psoralea* in America. Twenty-one species of palmate-leaved forms are defined, and 14 species of pinnate-leaved forms. Fewer changes in nomenclature were found to be necessary than usual in such a revision, and but one or two new species are proposed. Dr. Otto Kuntze is not followed in transferring all the species to *Lotodes* Siegesbeck.

Forschungs-Berichte über Lebensmittel und ihre Beziehungen zur Hygiene, über forense Chemie und Pharmakognosie is the title of a new journal edited by R. Emmerich, K. Goebel, A. Hilger, L. Pfeiffer, and R. Sendtner, all of Munich. Dr. E. Wolff's new scientific publishing house in Munich will publish the journal. No. 1 contains the beginning of a paper on the anatomy of the Cinnamomum bark, by R. Pfister (pp. 6–13). The list of contributors includes many distinguished names.—Bay.

The membership of the German Botanical Society, corrected to February, 1894, as given in the pages of the last annual volume of the *Berichte*, shows a total of 451, of which 27 are corresponding members and eight honorary members. The list includes five Americans: Dr. W. G. Farlow of Harvard University, Mr. J. Christian Bay of the Iowa Board of Health, Dr. Douglas H. Campbell of Leland Stanford University, Dr. Geo. L. Goodale of Harvard University, and Dr. Albert Schneider of Illinois Experiment Station.

Professor E. L. Greene is discussing and shifting generic lines in the Compositæ. In *Erythea* (April) the "Astereæ" are considered. The merging of Aster and Solidago, as has been done by Dr. Kuntze, is not accepted, it being claimed that there is such a thing as a genus Solidago distinct from Aster if it is stripped of its disguising appendages. He would, therefore, raise Euthamia to generic rank, and also exclude Nuttall's Chrysoma. Several species, also, that have been referred to Aplopappus are brought together under Sir William Hooker's genus Pyrrocoma.

Two vigorous articles in disapproving criticism of the present methods of teaching botany in the secondary schools have lately appeared in *Science*. One is by Miss K. E. Golden, of Purdue University; the other by Geo. H. Hudson, vice-principal of the State Normal and Training School at Plattsburgh, N. Y. Mr. Hudson wields a trenchant pen and his characterization of botanical instruction in high schools, though severe, is sadly too true. We hope he will reprint that article where as many teachers as possible will see it. We are entering upon the period of the *renaissance* for elementary as well as advanced instruction in botany.

[1] Jour. de Bot. 7: 434. 1893.

A NEW Ostrya, from Arizona (Yavapai county), within the Grand Cañon of the Colorado, is described and figured by Mr. F. V. Coville in *Garden and Forest* (March 21). Our only other species (O. Virginiana) extends westward to the meridian of E. Nebraska and E. Texas, and to discover a second species nearly a thousand miles west of this is a matter of considerable interest. The species was originally collected by Mr. Knowlton in 1889, without fruit, but the description was wisely withheld until fruiting specimens were obtained by Mr. Toumey in 1892. It bears the name of its original discoverer, being called O. Knowltoni.

THE NEW HAMPSHIRE COLLEGE of Agriculture and the Mechanic Arts, coöperating with Superintendent Gowing of the State Department of Public Instruction, will institute next July a Summer School of Biology, especially adapted to the needs of teachers in the secondary schools. The instruction in botany will be given by Principal Charles H. Clark, A. M., of Sanborn Seminary, Kingston, N. H. The school will open Thursday, July 5th, and continue until Saturday, August 4th. The course of study will cover the line of work in botany and zoölogy recommended in the recent report of the Committee on Secondary School Studies.

ANOTHER number of *Minnesota Botanical Studies* has appeared, bearing date of March 21st. Its six papers are: Nitrogen assimilation by Isopyrum biternatum, by D. T. MacDougal, in which the tentative conclusion is reached that the tubers are not primarily storage organs, but are probably concerned in the assimilation of free nitrogen; Morphology of hepatic elaters, by Josephine E. Tilden, in which the conditions of branching in the elaters of Conocephalus conicus are especially considered; Revised descriptions of Minnesota Astragali, Synonymy of the North American species of Juncodes (Luzula), and Further extensions of plant ranges, by E. P. Sheldon; Determinations of some Minnesota lichens, by W. D. Frost.

IN *Zoe* for March Mr. T. S. Brandegee continues his valuable studies of the flora of Lower California, a flora which he has done so much to elucidate. Over 70 plants new to the "Cape Region" are noted, several of them being new species, and one a new genus of Compositæ, dedicated to the distinguished botanical artist, Mr. C. E. Faxon. Mr. Brandegee also describes another new genus of Compositæ from the Coast range and dedicates it to Miss Alice Eastwood, the Curator of the herbarium of the California Academy of Science. *Faxonia* and *Eastwoodia* are each illustrated by a plate. The grasses of Mr. Brandegee's Lower California collection of 1893 are presented by Professor F. Lamson-Scribner.

IN THE *American Naturalist* (April) Professor L. H. Bailey asks the question, "Whence came the cultivated strawberry?" and answers that it is a direct modification of the Chili strawberry, Fragaria Chiloensis. He shows that this satisfies "the demand of history, philosophy and botanical evidence," and that we will have to give up "the pleasant and patriotic hypothesis" that it is the offspring of our native berry. "The strawberry is an instance of the evolution of a type of plant in less than fifty years, which is so distinct from all others that three

species have been erected upon it, which has been uniformly kept distinct from other species by the botanists who had occasion to know it best, and which appears to have been rarely specifically associated with the species from which it sprung."

IN THE *Annals of Botany* (Dec. '93) Professor J. M. Macfarlane continues his observations on "pitchered insectivorous plants," illustrated by three plates. Darlingtonia, Sarracenia, Heliamphora and Nepenthes are chiefly considered histologically and morphologically and their adaptations for insect-catching discussed. A large amount of patient observation is recorded, and the whole contribution is a valuable addition to our knowledge of this peculiar group of plants. The probable genetic relationships of these four genera are presented in a graphic way, in which it appears that from the "common type" two main branches diverged, one giving rise to Heliamphora, Sarracenia and Darlingtonia, the last being an offshoot of the second, and the other giving rise to the great display of Nepenthes, in which the specific relations are traced out in a similar way.

THE STATION BULLETINS recently issued include leaf blight of the pear, by L. F. Kinney (R. I., no. 27); spraying potatoes, by L. R. Jones (Vt., no. 40), an admirable bulletin; spraying apples and pears against fungi, by H. H. Lamson; potato diseases, by S. B. Green (Minn., no. 32); rational selection of wheat for seed, and typhoid fever, by H. L. Bolley (N. D., no. 15), the latter topic including a description of the germ, and its separation from natural waters, which causes a particular kind of fever; and a provisional bibliography of the more important works pub'ished by the U. S. Department of Agriculture and the agricultural experiment stations of the United States from 1886 to 1893 inclusive, on fungous and bacterial diseases of economic plants, by W. C. Sturgis (Conn., no. 118), a very valuable and apparently complete bibliography, which will prove of much service to investigators and writers.

THE THIRD SESSION of the Hopkins Seaside Laboratory of Leland Stanford Junior University will begin Tuesday, June 12, 1894. The regular course of instruction will continue six weeks, closing July 21st, though investigators and students working without instruction may continue their work through the summer. The laboratory provides for three classes of students: investigators; students in the university, who wish to supplement their work; and students and teachers not members of the university who desire to pursue biological studies and to become acquainted with the practical methods of laboratory work. For this last group of workers regular courses are conducted in zoology and botany, accompanied by lectures and by individual instruction at the work table. Mr. Walter R. Shaw, instructor in botany, in the university, gives a course in the comparative morphology of algæ. Advanced courses may also be arranged for.

The January number of the *Berichte der deutschen botanischen Gesellschaft* contains a paper by Kamienski on new and undescribed Utriculariæ. Frank and Krüger have a paper on the effect of treatment with copper on Solanum tuberosum. A. Schneider presents the results of his Rhizobia-studies, and Julius Klein describes the *Bau der Cruci-*

ferenblüthe auf anatomischer Grundlage. J. Christian Bay describes and figures his new infection-needle. In the February number, De Vries' paper, *Eine Methode Zwangsdrehungen aufzusuchen* forms a fine supplement to his monograph on the same subject. W. Tonkoff has a very interesting communication on swellings of the petiole in *Atragene alpina* L., a climbing plant. H. Zukal makes a communication concerning the much debated cell-contents of *Cyanophyceæ*, and A. Wagner gives the results of his investigations of the anatomy and biology of *Strelitzia reginæ.*—BAY.

PROFESSOR F. LAMSON-SCRIBNER has been appointed agrostologist of the Department of Agriculture, in the Division of Botany. This newly created position has thus been filled by our most critical student of grasses, and it will at once attract to itself the confidence and cooperation of botanists. The duties are as follows: "the identification of grasses and the investigation of forage plants in the Department; to prepare monographs on grasses; to care for the grasses of the herbarium; to identify such as may be sent for that purpose; to conduct correspondence on this subject, and to have charge of any special investigation of grasses and forage plants which may be undertaken by the Department." Professor Scribner needs no introduction to the readers of the GAZETTE, and the Department of Agriculture is to be congratulated upon this further evidence of its desire for competent scientific service.

WITH THE HELP of ten plates Mr. Hermann Schrenk discusses the parasitism of Epiphegus Virginiana, in a paper presented before the American Microscopical Society and now published in its Proceedings, 15: 91–128. A painstaking study of material and literature has evidently been made, though no very definite conclusions are reached concerning questions that were in doubt. There is much presented in work of this kind that may as well be omitted as not pertinent. If the study of each such parasite is to be preceded by an historical résumé of our knowledge of parasitism and a full account of the systematic relations of both host and parasite the resulting papers will be somewhat heavy and monotonous. It is necessary for the student to look up all this extraneous material but not to publish it. It seems to be a crying need just now, when such a multitude of contributions must be considered, for one to say what he has to say in the briefest possible way, and not to lead us gently to it by various circuitous approaches.